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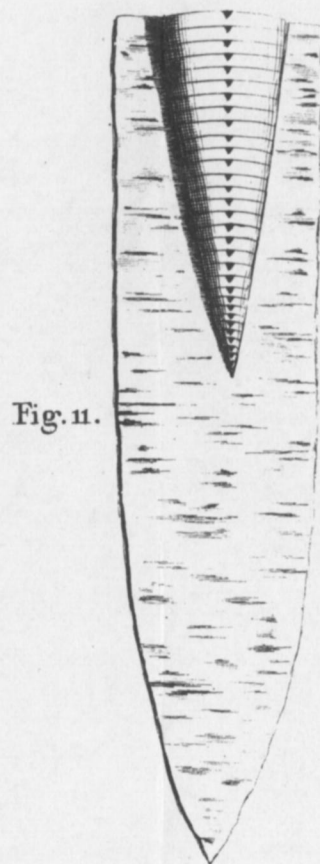
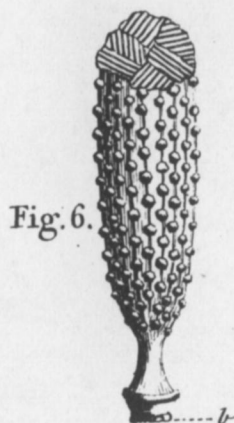
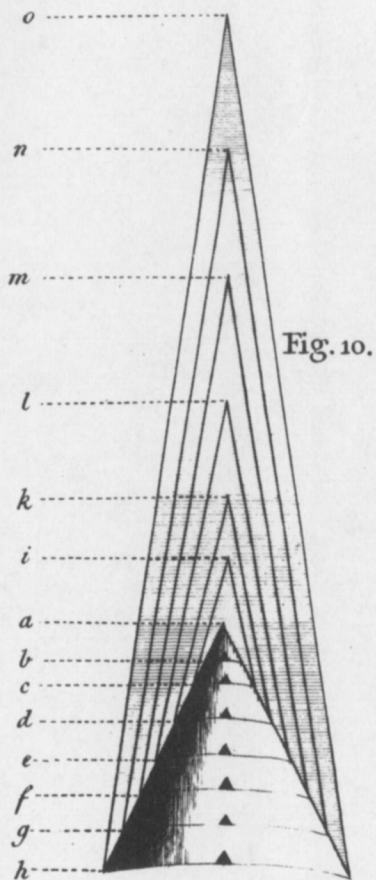
V. *An Attempt to Account for the Origin and the Formation of the Extraneous Fossil commonly called the Belemnite.* [*Vide* TAB. III. IV. V.] *By Mr. Joshua Platt.*

To the Right Honourable George Earl of Macclesfield President, and to the Council and Fellows, of the Royal Society, the following Attempt to account for the Origin and true Formation of the Extraneous Fossil commonly called the Belemnite, is humbly addressed, by

Their much obliged and obedient

humble Servant,

Joshua Platt.



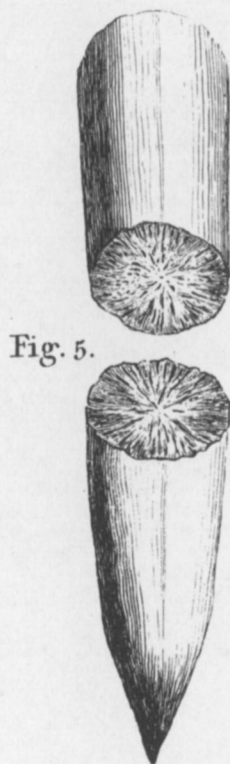




Fig 12



Fig. 13.

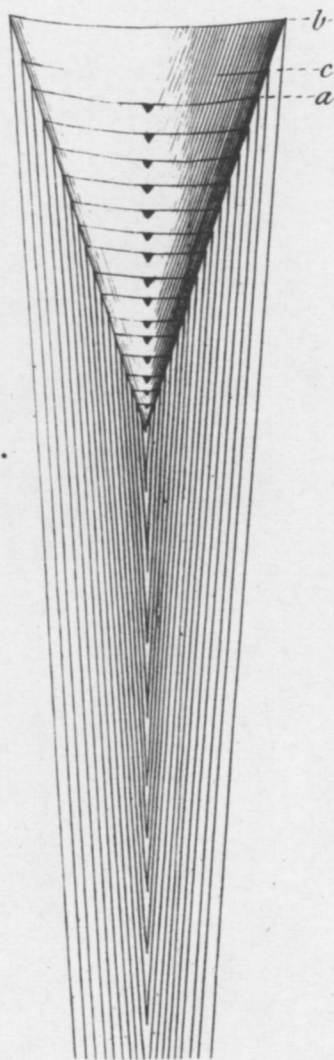


Fig. 14.



Fig. 14.



Fig. 4.

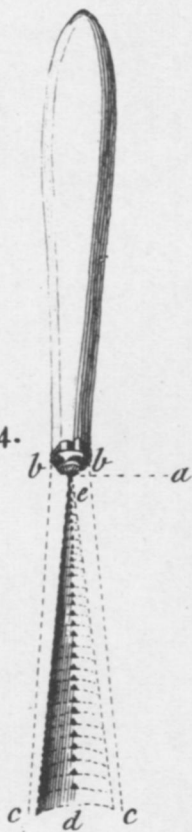


Fig. 2.



Fig. 3.

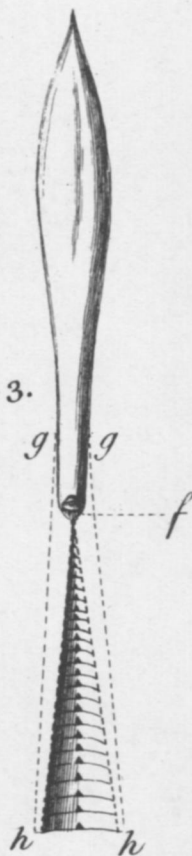


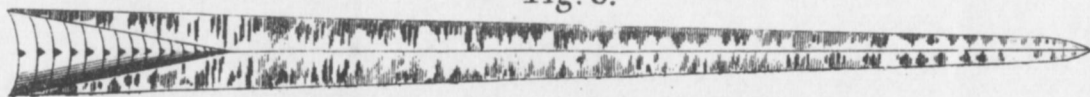
Fig. 17.



Fig. 15.



Fig. 8.



Found at Headington Stone pit near Oxon

Fig. 7.

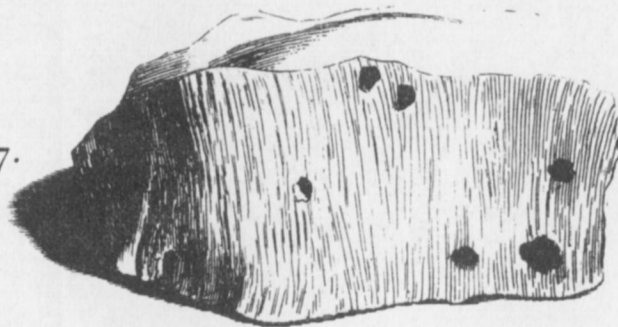


Fig. 16.



Fig. 9.



Read Jan. 26, 1764. **T**HE public hath of late been agreeably entertained with descriptions of many curious Fossils discovered in different parts of this kingdom: but very little hath been offered with a view to ascertain their origin and formation; a point of much greater importance to a curious mind, than the most accurate descriptions, or the neatest delineations. It may indeed be thought unnecessary at this time, to say any thing of the origin of extraneous Fossils in general; all our modern naturalists being fully convinced, that they are the exuviæ or remains of animals and vegetables, and the greater part of them of marine production.

But as to their particular origin and formation; in what manner they were produced in the recent, and how and with what matter they afterwards became impregnated in their fossil state; all this is a field of natural inquiry, that has been very much neglected, notwithstanding it is the most fertile and productive of useful and entertaining knowledge. Besides, were we to consider it in this view, the recent and fossil remains would be found to throw a mutual light upon each other, and the naturalist would not be so often at a loss to class every new fossil acquisition, of which the recent specimen is not to be found, especially whenever the fossil has any thing seemingly æquivocal in its formation, so as on a superficial inspection to render the matter doubtful, whether the body belongs to the animal or vegetable kingdoms, or indeed to either of them. One of the first note is the Belemnite, which has not until very lately been even ranked amongst the marine productions; but

but whose origin and formation have never yet been fully explained. I shall not enter into a minute detail of the several species of the Belemnite. The history of this extraneous fossil, or an attempt to account for the origin and formation of the Belemnite, so far as they can be discovered and confirmed by reasonings drawn from facts and experience, is the object of the present enquiry. I shall therefore confine myself to two species of the Belemnite; the one common in most counties of this kingdom, and vulgarly known by the name of Thunder-bolt [*a*]: the other that of the fusiform or Spindlekind [*b*], found in slate-stone at Stons-field, but in far greater plenty in the clay near Piddington [*c*] Oxfordshire; and in the chalk-pits of Kent and Surrey [*d*]. Those in chalk have been often mistaken for spines of the sea-hedgehog, or Echinus Ovarius; but the characteristics of these two bodies are widely different. The Belemnite breaks in a direction perpendicular to its axis [*e*]: the spine obliquely [*f*]. The Belemnite, when broken, exhibits central rays; the Spine a smooth resplendent surface. This distinction is invariable, if the trial be repeated a thousand times. These different appearances are probably the effects of different formations: and therefore the Belemnite seems to be formed by apposition, and the Aculeus or Spine by protrusion, or, as Mr. Reaumur calls it, by intus-susception. The radii in the Belemnite are owing to the fine laminæ, of which it is composed; they are so very thin, and break so nearly alike, that they have ever an horizontal surface when broken,

[*a*] TAB. III. Fig. 1. [*b*] Fig. 2. [*c*] Fig. 3.
 [*d*] Fig. 4. [*e*] Fig. 5. [*f*] Fig. 6.

which

which is common to all the shells of the trichite kind [g]. The spine being formed by protrusion, its component parts are adjusted on a different manner, and the pores like the cancelli in bones (though not so distinct) are irregular, which is the reason of its breaking obliquely in any direction, but it is generally smooth by being saturated with a plated kind of spar [h].

My ingenious and very worthy friend Mr. Brander, in a dissertation on the Belemnite, presented to the Royal Society [i], justly observes; “ that the Belemnite belongs to the testaceous part of the animal kingdom, and to the family of the nautili.” And I would beg leave farther to add, that this gentleman’s sentiments are greatly strengthened by the surprising analogy, which the Belemnite bears to the little pearly concamerated shell, or cornu Ammonis; and the orthoceratites, to the large nautilus; the former having its siphunculus upon the verge, as the latter has it in the center of the diaphragm, or partition, of each cell or chamber. “ It has indeed been truly matter of speculation (continues Mr. Brander) how this huge solid substance called the Belemnite, exclusive of the nucleus, could be formed; and how it happens, that some Belemnites should have the nucleus within them, others not; the cavity to

[g] Fig. 7. A piece of the Penna Marina, perforated by the Pholades.

[h] Spar seems to be nothing but crystal debased by a calcareous earth: the more debased sort breaks in a hairy trichite manner, the more pellucid kind with a smooth surface; and always in an oblique rhomboidal direction; which perhaps may in some measure enable us to account for its double refraction.

[i] Philosophical Transactions, Vol. xlviii. for 1754, page 803.

contain the same in some very small, in others scarce or not at all visible".— But I flatter myself, that it will be found upon enquiry, that these are only circumstances, which are common to other testaceous bodies, that have been accidentally broken or decayed by time, when forsaken by their inhabitants. For no testaceous body can be formed without an inhabitant; nor does it appear to me, that any Belemnite was ever formed without an alveolus, or concamerated shell.

The conical cavity and its nucleus are always proportioned to the bulk of the Belemnite, but not to its length: some are four times longer in proportion to the alveolus than others. The apex of the conical cavity, where the alveolus is first formed, in some runs up about half the length of the whole Belemnite; in others not a sixth part of the whole [*k*]: but the aperture, or upper chamber [*l*] is equally proportionable to the bulk, or circumference of the Belemnite, of whatsoever size or shape; and is the seat [*m*] or dwelling-place of the animal, that forms the Belemnite. In what manner this work is executed, I shall now endeavour to explain.

A considerable part of marine bodies, especially those of the testaceous tribe, are generally buried in mud or sand, except some few, which stick to rocks, &c. as the limpets and periwinkles; by which means we are prevented from making those remarks upon the several stages of their growth, which an accurate enquirer would desire. We must therefore have re-

[*k*] Fig. 8.

[*l*] Fig. xiii. *b. c.*

[*m*] We never find a Belemnite with part of the alveolus, but the vestigia or marks of the remainder appear in the cavity, and are continued to the verge of it.

course

course to the different steps or periods of their life and growth, as they are marked out by the indented lips or foldings of the shell; untill they arrive at their full size; when they begin to fortify themselves, by bulwarks and strong holds, against the injuries and incidents, which attend old age. This is most conspicuous in the cowree, or concha Veneris of Lister, book iv. sect. 9.

Mr. Reaumur [n] found, by repeated experiments, that land snails form their shells by juxtaposition: as the animal grows in bulk, the shell is increased by a mucous matter emitted from the body of the animal, which hardens by degrees into a testaceous substance: and from the experiments upon land shells that great naturalist concludes by analogy, that all testaceous bodies are formed in the like manner, particularly those of the turbinated kind.

To this general rule an objection is made by Mr. Poupert, from the formation of the cowree, or concha Veneris before mentioned: but this learned gentleman was not aware, that this shell is first a buccinum, forming many convolutions before it draws in the verge to form the indented lip.

It was this very objection of Mr. Poupert, which led me to examine into the growth of the cowree; and by sawing one of them through the middle, I found a turbinated shell within the outer wall, consisting of six or seven convolutions, but no stages, or periods, of the indented lip appeared in any of the convolutions, as we find in the helmet shell, and several of the buccinæ. I then began to consider how this animal enlarged its dwelling; and was fully convinced, that

[n] See his book of insects.

no more convolutions could be carried on; the indented lips being a full stop to its inward dimensions; and that here was the period of its growth. My sentiments were just as to its inward dimension; but observing that the lips of some were much larger than others, and that the curved part of the outer lip appeared thicker, when sawed open, than the other parts of the shell; I began to think, that the animal, instead of enlarging the inner dimensions, was employed in thickening the outer wall, to guard against injuries and accidents, so common to the inhabitants of that turbulent element the sea. I was the more confirmed in these sentiments by seeing the beautiful spots, with which this animal decorates its house, covered by other spots of different colour and size, as new laminæ were added to strengthen the last-formed convolution. It is really matter of admiration to see how these shells are adorned and variegated; the exquisite polish, which covers the whole infinitely surpassing the skill even of the most accomplished human artist. These new coverings or laminæ, which are carried from the lips, terminate in the middle of the back part of the shell; and there form a list, or seam, of a quite different colour from that of the other part of the shell, and of an unequal surface.

This very circumstance gave birth to my sentiments concerning the formation of the Belemnite: for whoever considers the seam or sulcus in the Belemnite, will, I think, conclude with me, that the outward lamina is formed latest, as in the cowree, and that the seam or sulcus is caused by the several additional coverings or laminæ terminating there. But as the anatomist makes fresh discoveries by dissecting the
subject,

subject, so (if I may be allowed the comparison) I received farther information by luckily meeting with a Belemnite, whose laminæ were in a manner dissected and laid open by the vague acid, or some other corroding menstruum, which every where pervades the earth, destroying some bodies [o], and forming others [p]. The laminæ of this truly wonderful body are here exposed to view [q], and plainly shew us, that nature, in this, as in all her works, pursues the most simple, easy, and shortest methods, though they appear ever so intricate and interwoven. This specimen will, I hope, serve to explain a matter, which hath so long puzzled the curious in natural history; and convince us, that there is nothing more wonderful in the formation of the Belemnite, than in that of a cockle, oyster, or any other testaceous substance; with this difference only, the oyster strengthens its shell, and excludes its first habitation, by additional laminæ formed *within*; the Belemnite incloses its dwelling by adding new laminæ *without*. Figure X. represents the Belemnite split up the middle, with the siphunculus in the front: *a, b* exhibit the first formed cell, or seat of the animal ab ovo. As the animal grows larger, it forms a second cell or chamber *b* to *c*, at the same time covers the first cell, by forming the appendage or guard *c, i*, which is the first stage of the Belemnite. In forming the third cell *c, d*, fresh laminæ or coverings are carried on from *d*, to *k*; and so of the rest, *e, f, g, h*; or *l, m, n, o*. When we have duly considered the manner, in which the shell is

[o] All calcareous substances.

[p] Such as selenites, pyrites, marcasites, talk, gypsum, &c.

[q] Fig. 9.

thus

thus formed; it will be no difficult task to account for the different sections and broken parts of the Belemnite; and in what manner they were reduced to the several forms or appearances, in which we commonly find them.

The better to illustrate my conjecture, I shall first exhibit some drawings, which shew the several specimens broken and imperfect; and then propose my sentiments concerning them before they were deserted by their inhabitants. Figure 6. shews the spine of the echinus ovarius broken obliquely, as is common to all of them. Figure 5. exhibits the inward structure of the Belemnite, when broken horizontally, with the central rays. Figure xi. is the same Belemnite split through its axis. Figure xii, and xiii, are broken in the same direction as Fig. 5. and xi, and shew how the several laminæ [*r*] are placed one over another in the manner, in which it is formed. Fig. xiv. shews the Belemnite in the most perfect state we ever find it. Fig. 4. is the fusiform Belemnite found in chalk, which has been often taken for a spine. *a*, which is the termination of the conical cavity, has been thought to be the *socket* of the spine, which receives the papilla, when growing to the echinus; but, when compared with the socket of the true spine [*s*], we find it widely different. The pricked lines *b*, *c*. *b*, *c*. shew what the fusiform Belemnite was, when perfect, with the alveolus *d*, *e*. Many of

[*r*] These distinctions of the laminæ I presume to be owing to the mineral steams insinuating themselves into the Belemnite, when the spar pervaded the pores, and destroyed the texture, but retained the true form by substituting its self, and filling the Plasm or mould of the Belemnite.

[*s*] Fig. 6. *b*.

I

those

those found in chalk seem to be somewhat injured at the end *a*, where they are deficient, and are rounded, but have an uneven surface, as if they had been gnawed or eaten by the pholas. Those found in clay near Piddington [*t*], Oxfordshire, approach nearer to the fusiform kind, and have a different appearance at the smaller end *f*, where the laminæ are reduced to a white impalpable powder, by corrosive juices in the earth, so as to stain the fingers when first taken out; and they afterwards retain a white chalky appearance: but, amongst a great number, I never found one that was three inches long. These have suffered in the same manner as Fig. iv. Fig. 3. *f*, shews where the alveolus terminates: *g*, *b*. *g*, *b*. how much has been destroyed by vitriolic acids [*u*]. At Stons-field they are found much longer than at Piddington, and are inclosed in stone, which is split by the workmen to make slates. Here we often find

[*t*] Fig. 3.

[*u*] It may be asked, why one part suffers more than another, as all parts are homogeneous, and free from extraneous mixtures? My answer is; because those parts, where the concamerated shell is lodged, are much thinner than the other parts of the Belemnite; and consequently the walls are more easily broken down, and the alveolus, being still less solid, is sooner destroyed, and reduced to an impalpable powder, by vitriolic and other acids, which the water takes up as it passes through different strata, abounding more or less with pyritical matter. Where no spar follows the acid, the parts are carried away and lost in the interstices of the earth, and a mould or plasma is left, which Steno calls an aerial shell. See his Prodomus, pag. 84. But where the spar abounds, it pervades the whole substance, fills up the cavity, and assumes the true form of the shell; and sometimes, by bursting the pores, is so far substituted in the place of the original particles, that the several diaphragms, with the siphunculus of the alveolus, are accurately and nicely preserved.

them

them in a much more perfect state [*w*] than the former, with the alveolus in many of them; but that part is commonly crushed [*x*] by the incumbent matter.

The siphunculus of the Belemnite is always upon the verge of the chamber, or cell; and in the siphunculus is a little gutt or ductus, proceeding from the body of the animal, by dilating or contracting of which the animal, it should seem, may go out or into its cell at pleasure. This is the only stay, which the animal has to secure its retreat: but I cannot agree with the learned doctor Hooke [*z*], *that the gut or ductus passes through all the cells to the end of the spiral cone*, either in this shell or the nautilus. His discovering of a spiramentum in the center of the latter was merely conjectural; for the ends of the spiral cone of concamerated shells [*a*] are shut up in the same manner with those of the turbinated kind: and it is common for all turbinated shell-fish, as they increase in bulk, and enlarge their shells, to leave their bottom or first-formed convolutions. Therefore I make no doubt but the same is done by the concamerated tribe; for if the gut go through only one or two valves, it will be a sufficient stay to the animal, and, being contracted or dilated, will serve all the purposes above mentioned. How far this is practicable by our little inhabitant, cannot absolutely be determined; but if it be constantly fixed by the gut to the siphunculus, it has a surprising power of contracting and dilating its body, to extend so far as the bottom or point of the Belemnite,

[*w*] Fig. 2.

[*x*] Ibid. at *y*.

[*z*] Hooke's posthumous works published by Derham 8°. p. 306.

[*a*] See the little pearly cornu-ammonis shell.

which

which in some is more than thirty times the length of the cell, into which it returns [b]. I am apt to think, that this gut or ductus, as well as the body of the creature, is capable of being extended very considerably, to serve all the uses of forming the Belemnite, without leaving the siphunculus; and that the gut serves for the same purposes with the tendons of the oyster; the latter to open and shut the shell; the former to allow the animal to go out and in at pleasure. And as the oyster feeds altogether in the shell, by opening the verge, the Belemnite (whose residence is in the great deep, which is seldom disturbed) very likely goes out in quest of food, but travels only upon the guard or rampart, leaving a trail behind, as all land snails do; which hardening into a testaceous substance, increases the dimensions of the outer walls, both in length and thickness, from the cell or chamber, to the bottom or point of the whole Belemnite. The animal in its progress and return clasps the whole guard, as a snail does a small branch of a tree in the gardens; and where the two sides meet, there the fulcus is formed, as is evident from the laminæ in Fig. 9.

The Belemnites, like all other testaceous bodies, have the vermicular tribe attached to them, and are perforated by the pholades. Other marine bodies also affix themselves to the Belemnites, oysters in particular: but this never happens whilst the animal inhabits the shell, because the new additional laminæ would so cover the affixed body, and also the cells of the pholades and vermiculi, that they could have no communication with the water, and must consequently

[b] Fig. 8.

perish. These bodies, thus attached, are the strongest proof we can desire, that the Belemnite is of marine production. Indeed it may be objected, that the bones of quadrupeds, wood, and stone have these bodies adhering to them, and therefore may be said to be marine, as well as the Belemnite. But when we bring them to chemical trial, the objection vanishes; for the bones either come out of the furnace with a black core, or they are reduced to ashes; whereas the Belemnite is changed into a fine calx, after the manner of all testaceous bodies, and is converted into a species of phosphorus [c]. The oysters, having no loco-motion, frequently affix themselves to other bodies, that they may be better able to stem the tides, and currents, which might otherwise carry them from their proper beds, and places of feeding. This attachment to other bodies no way incommodes them, because they increase the dimensions of their shells by adding fresh laminæ inwardly: the first formed laminæ, being, as it were, excluded, lie in the manner of tiles upon the roof of a house, and exhibit the several steps or stages of their growth.

I believe a Belemnite is very rarely found perfect in the fossil state: those in gravel-beds [d] have suffered very much by being rubbed against stones, &c. by the fluctuating waters: those, which we find in rubble at Garfington-pitts [e], have many adventitious bodies adhering to them, and consequently were deserted by

[c] The Belemnite after calcination, has all the properties of the Bolognian stone. If it be exposed a few minutes to the Sun, and immediately taken into a dark room, it will shine like Phosphorus for some time; and when the light diminishes, if again exposed to the Sun, its splendor will be renewed.

[d] Fig. xv.

[e] Fig. xvi.

their inhabitants before they rested there. In the clay at Shotover [*f*] near Oxford, they have a curious smooth surface, but are otherwise imperfect: at Stonsfield, in the slate-stone, they are generally crushed [*g*]: those approaching nearest to perfection, which I have seen, came out of the sand [*b*], under the bed of stone at Garfington-pitts near Oxford: the outer part is quite perfect, and the verge of the conical cavity is as thin as paper, but the alveolus is destroyed, except the apex or point. At Thame, in digging for stone, several small ones were found in a stratum of blue clay of a more cylindrical form [*i*]; some of which have the pearly substance still remaining; an incontestable proof of their being marine productions.

How much of the cavity is occupied by the alveolus, cannot be truly ascertained, until a perfect one can be found, which it will be hard to do in the fossil-state; but if we may judge from the nautilus, the walls are carried to a distance from the last formed valve, much greater than that, at which the valves are placed from each other; as in fig. xiii. from *a*, to *b*, which gives the animal all the convenience of forming a new valve or diaphragm, *c*. This circumstance has been very ingeniously cleared up by a learned physician in one of our monthly papers [*k*].

The recent nautili are very common in the eastern seas; and in the fossil state are frequently found with the Belemnites at Garfington near Oxford. Why may we not therefore expect to find a recent Belemnite,

[*f*] Fig. i.

[*g*] Fig. 2. y.

[*b*] Fig. xiii.

[*i*] Fig. xvii.

[*k*] Gent. Magazine for Jan. 1752. pag. 8.

as well as a recent nautilus, if a diligent person were strictly to examine the coasts, where the nautili are found? Persons commissioned to collect shells, and other curiosities, generally grasp at such things as feast the eye; not regarding those of less beauty and lustre, which would help us in our researches, and greatly illustrate the more useful parts of this study. A premium, offered by a Society of Vertuosi, might encourage our sea-faring gentlemen to search the several coasts, upon which they touch in their long voyages, and to use drag-nets as they do in drudging for oysters: from such assistance, variety of new subjects would be produced; and great improvements might be expected, if their inquiries should be successful.